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An institutional analysis of EPD programs and a global PCR registry

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Abstract
Purpose A Product Category Rules (PCR) document specifies the quantification method and communication format of environmental impacts of a product category. To ensure neutrality and credibility of quantitative environmental information, the development of PCR documents is defined in ISO 14025. Hence, the rules are preconditions for comparative considerations and modular application of information entities and Environmental Product Declarations (EPD). However, with the growing number of EPD programs, the producers, purchasers, and consumers feel increasingly alienated in relation to the validity and legitimacy of the environmental information presented by EPDs. This results in a need for enhanced transparency of PCR development and EPD program compatibility. This article offers navigational assistance in this respect.
Methods To identify harmonization potential, we compare PCR development regarding two aspects: quantitatively by mapping existing PCR and EPD documents, and qualitatively by comparing existing institutional structures with normative guidance. Information was gathered through an internet search and through direct correspondence with program operators.
Results and discussion We identified 27 programs, 556 PCR documents, and 3614 EPD declarations (May 2013). There were significant differences in activity level between programs and sectors. Furthermore, the institutional structures differ widely from each other and from normative guidance on PCR development.
Conclusions This first global PCR register guides practitioners in the search for PCR documents. The analysis of program institutional structures for PCR development and EPD verification indicates the involvement of different stakeholders on Type III environmental declarations. Regarding PCR compatibility and newly released guidance documents from the European Commission and the PCR Guidance Development Initiative, we recommend that operators (1) settle on a common (sector) categorization system, (2) implement a Stakeholder Identification Worksheet, (3) consider the mandatory involvement of consumer and environmental interests in the PCR review panel, (4) require PCR reviewers to declare potential conflicts of interest, and (5) consider installing mandatory third party verification of declarations for any external use.

Keywords EPD · EPD program · ISO 14025 · PCR development · Product Category Rules · Product environmental footprint

1 Introduction

The provision of environmental information for goods and services enables consumers and purchasers to choose products that have a lower impact on the environment (Defra 2007). This is believed to encourage the supply of such products (ISO 14025; discussions on this in Leire and Thidell 2005). With this aim, the European Union is exploring the options for businesses and consumers to measure and benchmark life-cycle resource efficiency (EC 2011). One instrument to implement this is the Type III environmental declaration, defined as a compilation of quantified life-cycle data according to predetermined parameters and, when relevant, additional

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environmental information (ISO 14025, clause 3.2). Apart from the ISO standardized Environmental Product Declaration (EPD), this also includes concepts such as that of the European construction sector according to the standard EN 15804 (2012), the EU developed Product Environmental Footprint (PEF according to EC 2013), and the ISO based Product Carbon Footprint (PCF) declaration (ISO/TS 14067, released after our survey). All these environmental claims have a two-step process in common, which consists of (a) setting common product category parameters, so-called Product Category Rules (PCR), and (b) declaring the life-cycle environmental impact according to these. Schmincke and Grahl (2006) explain how this separation of external involvement and in-house information processing was installed to guarantee neutrality and transparency on the one hand and efficiency of quantitative environmental information on the other hand.

Various researchers have published content analyses of PCR documents (Dahlbo et al. 2012; del Borghi 2008; Fet et al. 2009; Hauschild et al. 2013; Modahl et al. 2013; Schau and Fet 2008; and Wardenaar et al. 2012). The comparability of product information depends on the compatibility of these parameters. Nakaniwa (2003) optimistically assumed that programs would "be mutually recognizable in the near future." It turned out, however, that different stakeholders in different programs settled on inconsistent parameters and incompatible formats according to diverging methods (EC–JRC–IES 2011; Magerøy 2011; Subramanian et al. 2012). Ingwersen and Stevenson (2012) consequently recommend harmonizing basic program decisions referring to product classification, data requirement, and geographic scope. Whereas the ECO Platform – initiated by European construction EPD programs 2013 – aims at harmonizing the two latter based on EN 15804 (more on www.eco-platform.org), we explore a proposed classification in this article.

Ingwersen and Stevenson (2012) also point to the significance of "administrative processes of PCR development and use." This is the institutional perspective that is leading this paper, analyzing *how* and *by whom* program decisions are made. Obviously, single program decision cannot establish comparability of EPD documents alone but might be preconditions to this. A fully program compatibility may even be out of reach. On this background, this analysis provides a higher transparency of EPD program institutions. That is a precondition to any decision for or against mutual recognition among EPD programs, as del Borghi (2012) proposes.

2 Methods

EPD programs were identified through repeated internet search in the search engine Google. The keywords "eco-profile," "environmental claim," "environmental declaration," "environmental product declaration," "environmental profile," "EPD," "EPD program," "ISO 14025," "PCR," "PCR development," "product category rules," and "type III declaration" were entered in English, French, German, and Spanish. Only programs stating their conformity with ISO 14025 were registered. At the beginning of our study, no program had implemented the EN 15804 standard.

In this paper, quantitative data on PCR and EPD activity refer to document lists and published documents on EPD programs' web pages. Furthermore, the presented qualitative data on program processes and structures are based on the Program Instructions, which are published online by program operators to regulate the program processes. However, in most cases, operators were contacted for more detailed and comparable data.

Programs were grouped along two axes as baseline criteria: origin (public, private–public, or public) and market position (monopolistic or competitive). Then, we mapped program activity in order to register program contribution to rules and declaration development. For the first time, all worldwide accessible PCR documents were tentatively sorted according to a categorization system. We applied the UN CPC (UN Central Product Classification, v.2), because it has the advantages of being (a) international, (b) easy accessible, and (c) already in use by an internationally active EPD program and proposed for a planned Global PCR Library (Subramanian 2013). Documents without a UN CPC code from the operator were categorized referring to the PCR requisite element product category definition. However, some PCR documents were not available or were written in a non-European language and could only be categorized referring to the English title. Different product classification systems are presented in Ingwersen and Subramanian (2013).

The EPD/PCR ratio was calculated to point out the relation between costs and benefits of program tasks, because this is essential for enterprises before they engage in rules development. We further divided program structures into three core processes of EPD programs to analyze them separately: PCR development, PCR review, and EPD verification.

1. PCR development must be organized in an integrative way (ISO 14025, clause 6.7). Clause 5.5 requires "an open, participatory consultation with interested parties […] to ensure credibility and transparency." How are interested parties identified? How are they involved? Which interested parties actually participate in the PCR drafting or consultation?
2. The PCR review panel must contain different perspectives and competences of interested parties (clause 8.2). Which stakeholders are represented and how are they selected for the review panel?
3. EPD verification is essential for implementing PCR documents. Such verification must be conducted

independently. However, only in the case of communication directed at consumers does this imply third party verification (clause 9.4). How do programs handle this distinction?

Crespi and Marette (2005) argue that since green product characteristics are not visible, but stated, information credibility is crucial (for instance, the consumer cannot distinguish green power from fossil). Thus, if addressees cannot verify the information themselves, only trustworthy parameter setting and transparent verification procedures according to established conventions may compensate for this. Applying an involvement indicator, we analyze the different integration potential of programs structures. Such involvement mechanisms have also been addressed in the two different guidance frames for PCR development that have been published in 2013: the Product Environmental Footprint Guide [here: PEF Guide] of the European Commission (EC 2013) and the Guidance for Product Category Rules Development [here: PCR Guidance] of the PCR Guidance Development Initiative (Ingwersen and Subramanian 2013). Hence, during the last step of our research process, we compared these to existing program design. We hereby aim at (a) strengthening program transparency and (b) comparing the potential of producing harmonized PCR documents among the existing EPD programs. Due to its clear institutional perspective, this paper does not deal with methodological questions, e.g., data requirements and system boundaries.

Identified documents, categorization, and program data can be accessed in the Electronic Supplementary Material. The empirical research was conducted over a period of 15 months beginning in February 2012. All numbers were last updated in May 2013.

3 Results

3.1 Basic grouping of programs

A total of 27 EPD programs referring to ISO 14025 were found through internet search (Table 1). Applying the origin and market position axes, we distinguished four groups of programs:

A. Four programs originate from public initiatives or private–public cooperation *and* function as sole national programs for their state of origin. They treat consumer goods more often than others and were on average founded earlier.
B. Another five programs were co-initiated by government but have no monopolistic position. They compete in a free market with (inter-)national competitors.
C. Only two programs have private origin but function as sole national programs for their state of origin.
D. As many as 16 programs were initiated privately and compete in a free market. On average, these programs are younger. Nine of 13 programs specialized on the construction sector belong to this group.

The axis of origin joins A and B to (partly) publicly originated programs and C and D to fully privately originated programs. Along the axis of market position, A and C programs share a monopolistic position, whereas B and D programs act in an (inter-)national free market.

3.2 Mapping PCR and EPD activity

3.2.1 Program activity

Overall, 556 PCR and 3614 EPD documents were identified in this study (Table 2 and Electronic Supplementary Material). PCR documents include drafts, basic modules, valid, and expired documents, whereas EPD documents exclude declarations not based on a PCR document (see status legend in the Electronic Supplementary Material). However, documents are unevenly distributed: Six programs (ADEME, IBU, IES, JEMAI, KEITI, and PEP) account for 78 % of all PCR documents and 81 % of the EPD declarations. It must also be noted that only 16 programs were active during the survey period 2012/2013.

Productivity of programs can be defined by the number of published documents. Six of the eight most productive PCR developers (>10 PCR documents) are pioneer programs installed before 2006. Publicly initiated programs (A and B) together are responsible for 66 % of all PCR documents. Even though every second program belongs to group D, they have only developed 19 % of PCR documents. Regarding EPD productivity, A programs and D programs dominate with 60 and 31 % of all declarations. The EPD/PCR ratio indicates the efficiency of rules implementation in EPD programs. Thus, the 10 most efficient programs (>10 EPD/PCR) include only A and D programs. All A and D programs together have an average EPD/PCR ratio of 16, respectively 10, whereas B and C programs have registered one single EPD document for every PCR document.

3.2.2 Status of PCR documents

PCR documents run through a multi-stage participation and verification process to avoid bias and ensure credibility. Of the 556 PCR documents identified, the majority (73 %) are currently valid for use, 7 % are under development, whereas 20 % have already expired (Fig. 1).

On the one hand, 23 % of all once verified documents have expired without renewal. This is mainly due to two programs:

Table 1 Compilation of existing Environmental Product Declarations (EPD) programs

Operator type[a]	Program short	Program operator name in English	Founded in year	Country/ region	Origin[b]	Market position
A	ADEME	French Environmental and Energy Agency + AFNOR French Standard	2011	FR	Public	National
A	FDES	Environmental and Health Declaration Sheets + AFNOR French Standard	2006	FR	Prv–Pb	National
A	JEMAI	Japanese Environmental Management Association of Industry	2002	JP	Prv–Pb	National
A	KEITI	Korean Environmental Institute for Technology and Information	2002	KR	Public	National
B	CEPI	Confederation of European Paper Industries	2011	EU	Prv–Pb	Market
B	DAPc	EPD System for the Construction sector	2008	ES	Prv–Pb	Market
B	FP	FP Innovations	2011	CA	Prv–Pb	Market
B	IES	International EPD System	1998	SE, EU	Prv–Pb	Market
B	MVD	Danish Standard	2006	DK	Prv–Pb	Market
C	EDF	Environmental Development Foundation	2006	TW	Private	National
C	NEF	Norwegian EPD Foundation	2002	NO	Private	National
D	ASTM	ASTM International	2013	US	Private	Market
D	BRE	BRE	2008	UK	Private	Market
D	CLF	Carbon Leadership Forum	2009	US	Private	Market
D	EAA	European Aluminium Association	2005	EU	Private	Market
D	ecospec	Ecospecifier	2010	AU	Private	Market
D	IBU	Institute for Construction and Environment	2004	DE; EU	Private	Market
D	ICC-ES	ICC Evaluation Services	2012	US	Private	Market
D	IERE	Earthsure - Institute for Environmental Research and Education	2000	US	Private	Market
D	Ift	ift Rosenheim	2011	DE	Private	Market
D	NRMCA	National Ready Mixed Concrete Association	2013	US	Private	Market
D	NSF	NSF International	2011	US	Private	Market
D	PE	PlasticsEurope	2006	EU	Private	Market
D	PEP	PEP ecopassport	2007	FR; EU	Private	Market
D	SCS	SCS Global Services	2000	US	Private	Market
D	TGS	The Green Standard	2011	US	Private	Market
D	UL	UL Environment	2011	US	Private	Market

[a] Program grouping as described in chapter 3.1: A public origin and national function, B public origin and competitive position, C private origin and national function, and D private origin and competitive position

[b] Private–public origin is abbreviated with Prv–Pb

most expired ruling documents were developed within the IES program (75 of 110), 19 others turned invalid after their institutional frame, the EDF program, stopped its PCR development activity. On the other hand, most identified PCR drafts are registered by the IES (33 of 38), the only program which announces the progress of its PCR development in detail.

3.2.3 PCR documents according to sector

A tentative PCR break-down based on the UN CPC sections and EPD programs shows the intensity of rules development in different sectors (Fig. 2).

PCR development has come especially far in sections 3 (Transportable goods: 200 documents) and 4 (Metal products, machinery, and equipment: 218 documents). This includes intermediate products for the construction sector as well as electric and electronic products for the consumer market. Drivers for PCR development in this field are especially the building sector programs in Europe (BRE, DAPc, IBU, ift, and NEF) and the Asian programs dealing chiefly with electric and electronic equipment (EDF, JEMAI, and KEITI). It should also be noted that rules development in section 2 (Food and beverages, apparel, and textiles) has resulted in 64 documents, above all due to the work of the IES. This B program operator has contributed significantly to all sections.

3.2.4 EPD publication according to sector

Assigning published EPD to PCR documents produces a somewhat different sectorial distribution (Fig. 3). Section 4 has by far the most registered declarations (1940), followed by section 3 (770), section 2 (460), and section 5 (349). A look at the program contribution shows that relatively efficient programs contribute especially to sections 4 (JEMAI and PEP), 2

Table 2 Numbers of Product Category Rules (PCR) and Environmental Product Declaration (EPD) documents of programs, ranked by the EPD/PCR ratio

Program	Operator type	Main goods covered	PCR	EPD	EPD/PCR ratio (rounded)	Activity 2012/2013[a]
PEP	D	Industrial	1	407	407	1
FDES	A	Industrial	1	248	248	1
BRE	D	Industrial	1	80	80	1
UL	D	Industrial	2	59	30	1
ADEME	A	Consumer	19	347	18	1
JEMAI	A	Industrial/ consumer	80	1,258	16	1
PlasticsE	D	Industrial	1	12	12	1
Ift	D	Industrial	11	111	10	1
KEITI	A	Consumer	34	310	9	0
ICC-ES	D	Industrial	1	9	9	1
DAPc	B	Industrial	3	21	7	1
NEF	C	Industrial	19	118	6	1
IBU	D	Industrial	76	408	5	1
TGS	D	Industrial	2	5	3	0
FP	B	Industrial	1	2	2	0
IES	B	Industrial/ consumer	223	202	1	1
IERE	D	Industrial/ consumer	6	4	1	1
EDF	C	Consumer	62	0	–	0
MVD	B	Industrial	5	0	–	0
NSF	D	Industrial	3	0	–	0
Ecospecifier	D	Industrial	2	0	–	0
CEPI	B	Industrial	1	0	–	0
CLF	D	Industrial	1	0	–	1
EAA	D	Industrial	1	0	–	0
NRMCA	D	Industrial	0	1	–	1
ASTM	D	Industrial	0	0	–	0
SCS	D	Industrial	0	0	–	0
Sum A	**4**	**–**	**134**	**2,163**	**16 (ratio)**	**3**
Sum B	**5**	**–**	**233**	**227**	**1 (ratio)**	**2**
Sum C	**2**	**–**	**81**	**118**	**1 (ratio)**	**1**
Sum D	**16**	**–**	**108**	**1,106**	**10 (ratio)**	**10**
Overall sum	**27**	**–**	**556**	**3,614**	**7 (overall ratio)**	**16**

[a] 0 indicates inactivity; 1 that new documents were registered during the survey period from February 2012 to May 2013

(ADEME and others: UL), and 5 (Others: BRE and FDES). Some of these are single PCR programs using a sole PCR document for all declarations (BRE, FDES, and PEP). Whereas sections 1 and 6 count 34 and 54 declarations, respectively, sections 0, 7, 8, and 9 add up to only seven EPD documents.

3.3 Rules development and implementation

For the next subchapters, qualitative information is presented in the following order to be comparable: ISO requirements, collected data on EPD programs (as listed in the Electronic Supplementary Material), and guidance recommendations.

Out of a total of 27 programs, information on PCR development structures was available for 22. Nineteen provided information about actual stakeholder participation in the PCR preparation and 21 about review panel composition for the PCR verification. The EPD verification requirements were specified in 22 cases. Until the closure of our survey, we received no response on e-mail questions from the programs DAPc, EDF, ICC-ES, IERE, MVD, NEF, and TGS. No data were available for the program ecospecifier.

3.3.1 Integrative PCR development

According to ISO 14025, the program operator is responsible for drafting the PCR under the involvement of the interested

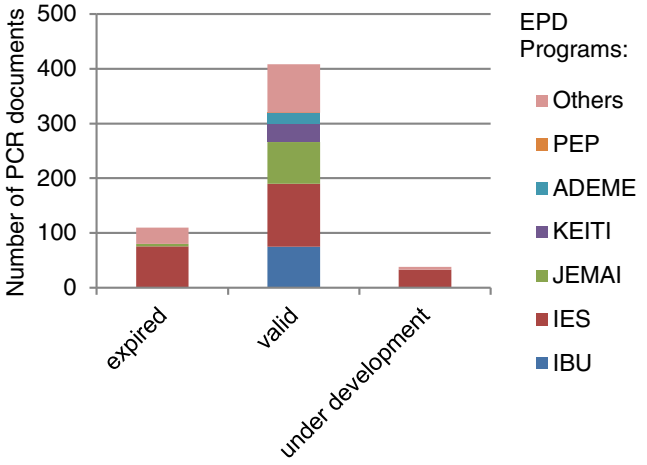

Fig. 1 Status of the Product Category Rules (PCR) documents

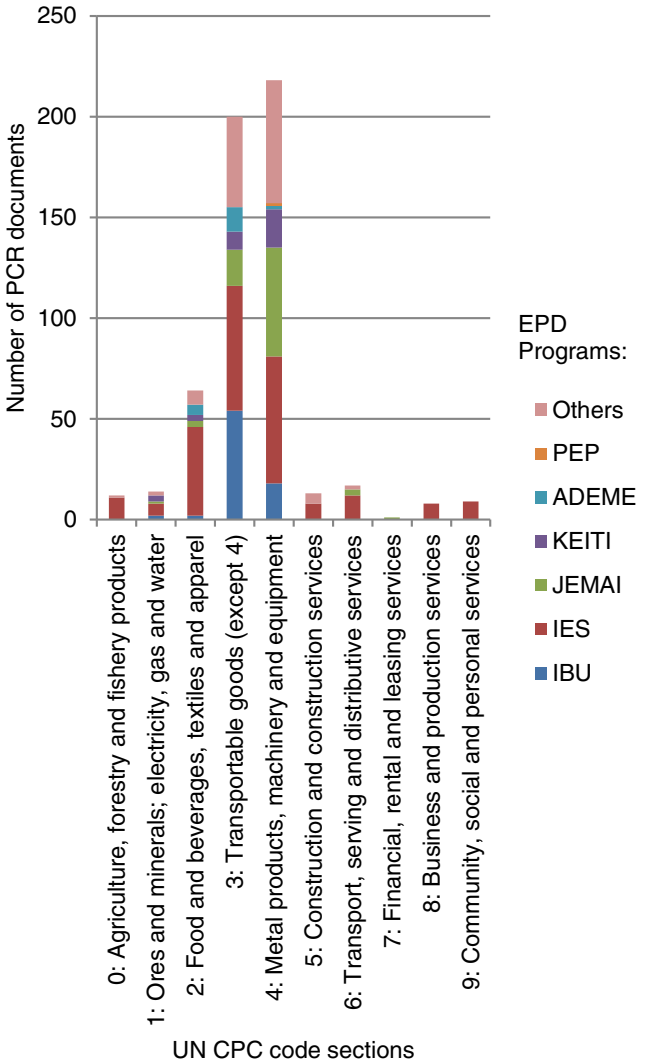

Fig. 2 Product Category Rules (PCR) documents according to Environmental Product Declaration (EPD) programs and UN Central Product Categorization (UN CPC) sections

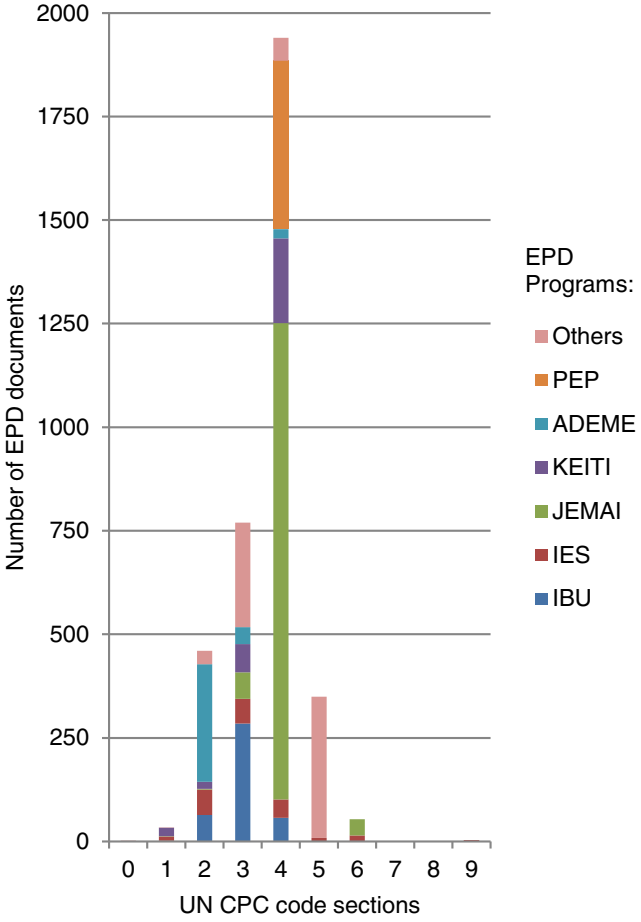

Fig. 3 Environmental Product Declaration (EPD) documents according to Environmental Product Declaration (EPD) programs and UN Central Product Categorization (UN CPC) sections (as specified in Fig. 2)

parties. The standard provides examples of interested parties to an EPD program: "material suppliers, manufacturers, trade associations, purchasers, users, consumers, non-governmental organizations (NGOs), public agencies and, when relevant, independent parties and certification bodies" (clause 5.5). The involvement mode is only required to be an open, not necessarily public consultation (ISO 14025, clause 6.7.1). However, decisions should be made in a consensual way.

How is this implemented in programs today? Most operators (18) delegate the responsibility of PCR drafting to a PCR committee, ensuring the involvement of stakeholder types such as manufacturers, business associations, and sometimes researchers. Commonly, authorities and non-governmental organization do not participate on this stage. However, 18 operators generally specify stakeholders in their program instructions. Differentiating the following seven stakeholder types, we registered

- manufacturers (19 times),
- business associations (18),
- authorities (15),

- civil society/non-governmental organizations (14),
- purchasers (11),
- consultants (11),
- researchers (11).

There is no correlation between stakeholder definitions and program groups.

One program operator (JEMAI) does not fulfill the ISO requirement of an open consultation. In nine cases, consultation is limited to parties selected by the program operator, i.e., the specified stakeholder list above. The alternative is a public consultation open to anyone, as conducted by 12 programs. Seven of these in addition invite selected interested parties directly. On the one hand, this secures that identified stakeholders are informed about the PCR development. On the other hand, it allows any institution to declare itself an interested party. Thus, these programs can guarantee that stakeholder types such as civil society and authorities also have the possibility to contribute. That is also assumed to be the case for the two A operators (ADEME and FDES) who organized the consultation as integrated hearings in a standardization process; all kinds of stakeholders could be reached. The same approach was applied for the development of the common core PCR for the European construction sector (EN 15804 2012).

The actual participation of interested parties shows a disproportional representation of stakeholders. Manufacturers and business associations participate in most consultations (17 and 16 cases), followed by consultancies, and researchers (11 and nine cases). Authorities participated in eight cases, whereas civil society was only identified in four cases. Here, results differ according to program groups: Type A operators invite the most stakeholder types (in average six out of seven types), whereas other operators invite between three and four stakeholder types on average. Most programs fail to involve civil society in the open consultation. The concrete participator lists in standardization processes (ADEME, FDES, and EN 15804) were not accessible.

According to the EU *PEF Guide* (EC 2013), a Technical Secretariat, mostly led by the PCR initiator, is responsible for the PCR drafting. It shall identify relevant stakeholders and invite them to two consecutive public consultations. The interested parties are specified as according to ISO 14025, and decisions should be consensus based. Stakeholder involvement has to be internally documented. The *PCR Guidance* (Ingwersen and Subramanian 2013) goes beyond the international standard. Firstly, it requires that no single organization may hold more than 50 % of committee members. To assure this, signed conflict of interest forms by all draft committee members have to be published. Secondly, it recommends a minimum representation of different stakeholder types in the PCR drafting committee: Two independent manufacturers, one LCA expert and one interested party (e.g., non-governmental or governmental organization). The consultation is required to be conducted actively in order to reach out to all relevant stakeholders. Lastly, the PCR Guidance proposes a "Stakeholder Identification Worksheet" to document stakeholder identification, their interests, and actual involvement in the PCR development.

3.3.2 Independent PCR review

The PCR review has to be conducted independently of the PCR drafters and the EPD program operator (ISO 14025, clause 8.1.2). Reviewers have to comply with minimum industry and LCA competences (clause 8.2.3).

Consultants and researchers were by far reported to be the best represented groups in PCR review panels (17 and 15 cases). In eight cases, manufacturers and business associations are represented as well. Authorities and civil society were represented seven and three times. Results differ according to program groups: Type A operators involve most stakeholders on average (4.25) and from different stakeholder types. With few exceptions, B, C, and D operators (3, 2, and 2.3 stakeholder types on average) lack state and civil representatives in their review panels. Manufacturers, consultants, and researchers are especially well represented in D programs.

The *PEF Guide* includes two reviewing stages: Before the second consultation round, the PCR draft shall be approved by the Pilot Steering Committee, which consists of the PCR Technical Secretariat coordinators, representatives of the Commission, of civil society (consumer, environmental, and SME interests), and the member states. Furthermore, the Technical Secretariat selects the members of the expert PCR review panel. Together, this ensures civil and state involvement as well as expertise.

The *PCR Guidance*, however, installs no mechanism to secure representation in the review panel. It requires two LCA experts and an industry expert to be represented. Signed conflict of interest forms ensure the independence of the review panel. According to the guidance paper, the PCR committee will respond to comments from the consultation round and the review panel. Potential unresolved comments will be included in the PCR review report.

3.3.3 EPD verification alternatives

The international standard requires program operators to install an "appropriate verification process" (ISO 14025: 8.1.1), thus generally accepting internal verification. Only in the case of declarations directed at consumers is third party verification required (ISO 14025, clause 9.4).

All programs, except for one (JEMAI), conform to the extra requirement regarding consumer directed declarations. Furthermore and independently of program types, 13 programs require third party verification on business directed

declarations as well. Mostly, program operators are responsible for appointing an external verifier for LCA data and EPD compilation. In the case of some A and D programs, the program operators offer data compilation as well as verification, i.e., they cannot guarantee third party verification separately from the LCA conductor.

Neither the *PEF Guide* nor the *PCR Guidance* contains EPD verification procedures in their scope.

3.3.4 Involvement indicator

Throughout the described core processes of EPD programs, program operators ensure different levels of interested and third party involvement. Concentrating on stakeholders who are not directly driven by economic factors, e.g., civil society and state authorities, we propose an indicator consisting of three aspects for program involvement potential:

1. Participation possibility: Almost all reporting programs (20 of 23) of all operator types secure this through an active identification of defined stakeholders combined with a private consultation or through an open consultation.
2. Participation guarantee: A third of operators (five A or B programs, two C or D programs) involve authorities or civil society in the review process.
3. Precautionary appropriate verification: Some programs (three A or B, five C or D programs) ensure that all published declarations are verified by an external third party, separate from the LCA conductor.

4 Discussion

4.1 On efficiency in rules development

Program groups have different productivity and efficiency of rules development. Our numbers are not intended for program ranking but for analyzing costs and benefits of this central program task. Productivity differences partly correlate to program age and sector circumstances and partly depend on program institutional structures as reported in chapter 3.3. Please note that results are based on a mall number of program cases.

Putting the efficiency of rules development in relation to program institutional structures, we find the following explanations for rules efficiency: The highest EPD/PCR ratio (>50) is reached by single rules programs established in 2006 and 2007: FDES, BRE, and PEP are examples of programs of type A and D serving a whole sector with one sole PCR development process. However, a closer look at the program structure shows some deficiencies in their rules and/or in verification procedures. This results in less transparency and problematic comparability with other programs. For example, PEP has in fact published 1,231 declarations of which 824 lack a required Product Specification Rules (PSR) document completing the PCR document, and FDES has registered 1,114 declarations, of which only 248 have been verified independently according to the rules (see document status in the Electronic Supplementary Material).

Adopting PCR documents also increases efficiency (EPD/PCR ratio >25). Operators that apply PCR documents of other programs reduce their own work load in PCR development, e.g., the D operator UL has developed over 50 declarations based on rules from other programs. This makes sense in economic terms since PCR development is a collaborative and costly process, whereas LCA services, EPD verification, and registration are income sources of some free market operators.

Relaxing circumstantial involvement procedures might ease PCR development. Some program operators of different types with high efficiency (ratio >8) have loose verification regulations (ADEME and JEMAI) or do not guarantee the representation of environmental and consumer interests in spite of publicly accessible declarations (ICC-ES and ift). Such diverging practices are a hinder for comparability. However, there is no general correlation between efficiency and a low involvement indicator. On average, A and B programs fulfill the most of the three involvement aspects (average 1.86), followed by D and C programs (average 1.36).

4.2 On categorizing products

Mapping PCR and EPD activity is difficult due to the lack of compatibility between functional product categories and the material and production based product classification system. Thus, PCR documents may be assigned to more than one UN CPC class as done by Subramanian (2013). However, especially construction products do not fit easily into the UN CPC material based system. As more than a third of registered EPD documents belong to this sector, a separate categorization should be explored.

Our collection and categorization of PCR documents were further hindered by language and access difficulties. Firstly, key information in English on every document and its development is missing in some European and Asian programs. Secondly, one program demands a fee for its PCR documents (ADEME).

4.3 On involving stakeholders

There is a gap between the specified interested parties and the actual participating stakeholders: Civil society and authorities seldom contribute to consultations and are weakly represented

in review panels. Especially operators of type D lack balanced stakeholder participation.

How can program operators create efficient involvement structures? The Stakeholder Identification Worksheet of the *PCR Guidance* seems to be an effective instrument for documenting the measures and achievement in identifying and involving all interested parties. Regarding the PCR review, the PEF Pilot Steering Committee includes state and civil society interests in the review panel; however, this model is highly dependent on EU governance structures and is not transferable. On the other hand, the *PCR Guidance* suggests rules for minimum representation in the drafting committee. This includes a member of a non-governmental or governmental organization. But involving civil society is momentarily not implementable, because costs and knowledge barriers are reported to be too high. The American Center for Life Cycle Assessment has proposed prescribing their involvement rather in the PCR review panel (ACLCA n.d.): The review task is mostly compensated and would offer civil society a real chance to participate. In that way, operators could guarantee balanced involvement. Furthermore, the *PCR Guidance* requires all reviewers to declare that they have no conflict of interests. Such a low-cost measure can increase the credibility of the PCR document.

Generally, EPD verification is today subject to the operators' discretion, whereas third party verification of consumer directed declarations is specified. This is unspecific in two ways: When is communication aimed at consumers and what is a third party? First, the ISO 14025 differentiation between business and consumer communication ignores a grey zone: Declarations aimed at business partners which are used externally for comparative assertions and/or possibly published on the internet without special addressees. To harmonize the verification procedures to mandatory external verification for all declarations is costly. Nevertheless, our survey shows that many operators of type D already favor third party verification.

Second, A and D programs offer LCA calculation and EPD verification services. In the case of consumer communication, third party EPD verification can actually be performed by the same organization that conducts the LCA study and compiles the EPD declaration.

5 Conclusions

In a dynamic field of operators with different origin and market position, how can this paper contribute to transparency and eventually compatibility?

On the one hand, we state that some cost-saving strategies, e.g., single PCR programs and relaxed verification procedures, impair declaration transparency, and comparability. On the other hand, accessible PCR documents should be adapted if possible. It saves time, effort, and costs to draw upon existing work. As a first and explorative global PCR register, this paper and the Electronic Supplementary Material on existing PCR development and EPD registration can guide *practitioners* in the search for suitable documents. Applying one or more categorization systems enables rules developer to define new product groups and find useful modules along the production chain. Therefore, further efforts should be undertaken to integrate our data into a dynamic central library for PCR documents.

First, the reference value of Type III environmental claims depends on credibility. *Policy makers and operators* must assure purchasers and consumers that procedures for parameter setting are fair and the published data are correct. The most important measure for this is involvement in PCR development and transparency in EPD verification. Program operators can raise the credibility of parameter setting and declarations if they guarantee the involvement of certain stakeholders and ensure the separate third party verification of the content.

Going further, PCR harmonization depends among other things on procedural alignment (Ingwersen and Subramanian 2013). To achieve this, institutional structures must be made compatible. For the construction sector in Europe, this was partly ensured through the standardization process to create basic parameters in the form of a core PCR (Schmincke 2011). However, the specification of this common base is carried out in different program structures and the participating program operators are confronted with non-European program operators and other stakeholders. Thus, for them and for the development of new and the renewal of expired PCR documents, we recommend the following harmonized and transparent procedures as (partly) encompassed in the *PEF Guide* and the *PCR Guidance*:

- Settle on an international (sector) categorization system.
- Implement the Stakeholder Identification Worksheet.
- Consider mandatory involvement of consumer and environmental interests in the review panel: is compensated participation possible?
- Require reviewers to declare possible conflicts of interest.
- Consider installing mandatory external third party verification of all declarations for external use.

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